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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/601,958	08/10/2000	JYOTI KIRON BHARDWAJ	WLJ.056	5262

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EXAMINER	
HASSANZADEH, PARVIZ	

ART UNIT	PAPER NUMBER
1763	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/601,958	BHARDWAJ ET AL.	
	Examiner	Art Unit	
	Parviz Hassanzadeh	1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 March 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-24 and 29-49* is/are pending in the application.

4a) Of the above claim(s) *3,5,10,11,16-20,22-24 and 29-49* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4,6-9,12-15 and 21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *10 August 2000* is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Applicant's election without traverse of Species 1, Group 1, claims 1, 2, 4, 6-9, 12-15, 21 and 26-28 in Paper No. 12 is acknowledged.

Claims 3, 5, 10, 11, 16-20, 22-24 and 29-49 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected Species and method, there being no allowable generic or linking claim. Election was made **without** traverse in Paper No. 12.

It is also noted that claim 2, 25-28 and 50 have been cancelled in the Amendment filed on 3/12/04.

Claim Objections

Claims 31, 47 and 48 are objected to because of the following informalities: claim 31 (nonelected) is missing, the second occurrence of claim 47 and claim 48 should be changed to claims 48 and 49, respectively. Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly

owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bhardwaj et al (EP 0822582 A2) in view of Shintani et al (US Patent No. 6,076,483).

Bhardwaj et al teach a plasma processing apparatus (Fig. 1) comprising:

a vacuum chamber 11 having a support 12 for a substrate 13;

a gas inlet port 18 into the chamber through which deposition or etching gases can be introduced;

wherein the alternating reactive ion etching (RIE) and depositing a passivation layer by chemical vapor deposition (CVD) is performed, wherein one or more of the following parameters: gas flow rates, chamber pressure, plasma power, substrate bias, etch rate, deposition rate, cycle time and etching/deposition ratio vary with time (*means for alternately and repeatedly introducing an etch gas and a deposition gas into the chamber through the at least one gas inlet, wherein the deposition gas is different from the etch gas, wherein the deposition gas is for the deposition step of each cycle in which a passivation layer is deposited on the substrate and the etch gas is the etch step of each cycle in which the passivation is selectively removed*);

an RF source 16 coupled to the coil 15a (*means for striking a plasma into the etch and the deposition gas alternately introduced into the chamber*); and

a plasma bias which can be either RF or DC can be connected to the support electrode 12 so as to influence the passage of ions from the plasma down on to the wafer 13 (*means for accelerating the available ions onto the substrate*) (abstract, page 3, line 49 through page 4, line 17).

Bhardwaj et al fail to teach attenuation means for partially reducing the ion flux from the plasma so that sufficient ions are available to selectively remove the passivation layer during the etch step of each cycle.

Shintani et al teach a plasma processing apparatus (Fig. 1) including an partition panel 24 provided between processing chamber 21 and plasma generation chamber 22, wherein the partition chamber having a plurality of holes 24a allowing plasma ions to pass therethrough. The partition panel provides a high density plasma generation chamber and a low pressure processing chamber so that a fine pattern processing on a substrate can be formed (*a grid 18 as shown in Fig. 6 of the present application, page 22, a means for partially reducing ion flux from plasma*) (column 6, line 1through column 7, line 15).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the partition panel as taught by Shintani et al in the apparatus of Bhardwaj et al in order to provide a high density plasma generation chamber and a lower pressure processing chamber which improves the process of forming fine pattern on a substrate.

Further regarding the function associated with the partition panel: some of the plasma ions are neutralized or stopped through collision with each other or other plasma species or with the panel during the process of passing through the partition panel 24 and thus the partition panel inherently would partially reduce the ion flux from plasma during the passage of the ions through the panel.

Claims 4, 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bhardwaj et al (EP 0822582 A2) in view of Shintani et al (US Patent No. 6,076,483) as applied to claim 1 above, and further in view of Amemiya (EP 0,488,393 A2).

Bhardwaj et al in view of Shintani et al teach all limitations of the claims as discussed above except for explicitly disclosing a portion of the chamber is formed of a dielectric material.

Amemiya et al teach a plasma processing apparatus wherein a plasma generation upper section 26 is made of quartz (dielectric material) and wherein plasma generation electrodes 28 are proved outside and around the section 26 so power is transmitted through the dielectric material and a plasma is generated within the section 26 (column 5, line 1).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to used a dielectric material such that taught by Amemiya et al for the chamber wall of the apparatus of Bharwaj et al so plasma generating power is transmitted through the wall and a plasma is formed within the chamber.

Further regarding claim 6: as shown in Fig. 1 of Bhardwaj et al, the inductive antenna 15a is disposed around the chamber 11.

Claims 1, 4, 6-9, 12, 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bhardwaj et al (EP 0822582 A2) in view of Ohkawa et al (EP 0831516 A2).

Bhardwaj et al teach a plasma processing apparatus (Fig. 1) comprising:

a vacuum chamber 11 having a support 12 for a substrate 13;

a gas inlet port 18 into the chamber through which deposition or etching gases can be introduced;

wherein the alternating reactive ion etching and depositing a passivation layer by chemical vapor deposition is performed, wherein one or more of the following parameters: gas flow rates, chamber pressure, plasma power, substrate bias, etch rate, deposition rate, cycle time and etching/deposition ratio vary with time (*means for alternately and repeatedly introducing an*

etch gas and a deposition gas into the chamber through the at least one gas inlet, wherein the deposition gas is different from the etch gas, wherein the deposition gas is for the deposition step of each cycle in which a passivation layer is deposited on the substrate and the etch gas is the etch step of each cycle in which the passivation is selectively removed);

an RF source 16 coupled to the coil 15a (*means for striking a plasma into the etch and the deposition gas alternately introduced into the chamber*); and

a plasma bias which can be either RF or DC can be connected to the support electrode 12 so as to influence the passage of ions from the plasma down on to the wafer 13 (*means for accelerating the available ions onto the substrate*) (abstract, page 3, line 49 through page 4, line 17).

Bhardwaj et al fail to teach attenuation means for partially reducing the ion flux from the plasma so that sufficient ions are available to selectively remove the passivation layer during the etch step of each cycle.

Ohkawa et al teach a plasma processing apparatus (Fig. 1) including a magnet 30 generating magnetic field parallel to the surface of the substrate for insulating the substrate 26 from free electrons in the plasma. By applying appropriate potential on the substrate or an inside electrode 40, ion etching/deposition or neutral etching processes, respectively, can be performed (column 7, line 46 through column 8, line 2; and abstract and column 6, line 19 through column 8, line 2).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the magnetic field generating device as taught by Ohkawa et al in the apparatus of Bhardwaj et al in order to insulate the substrate from free electrons in the plasma.

Further regarding claim 1: the magnetic filed as taught by Ohkawa et al removes electrons from plasma region towards the chamber sidewall. This magnetic filed would inherently cause some of the plasma ions to be attracted towards the wall and thus cause a partial reduction in the plasma ion density (see also page 19 of the present application).

Regarding claim 4: the side wall of the chamber in inductively coupled plasma source are known to be made of a dielectric material such as quartz, for example, the vessel 12 is made of an insulating material (dielectric material) such as glass (column 6, lines 19-31).

Regarding claim 6: as shown in Fig. 1 of Bhardwaj et al, the inductive antenna 15a is disposed around the chamber 11.

Regarding claim 7-9, 12, 21: the magnetic field as taught by Ohkawa et al may be produced by a permanent magnet or an electro-magnetic device (column 7, lines 2-16).

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bhardwaj et al (EP 0822582 A2) in view of Ohkawa et al (EP 0831516 A2) as applied to claims 1, 4, 6-9, 12, 21 above, and further in view of Kin (JP61-39521 A).

Bhardwaj et al in view of Ohkawa et al teach all limitations of the claim as discussed above except for the attenuation means (magnetic generating filed) comprising a tubular member carrying magnets.

Kin teaches a plasma processing apparatus including a pole-like electrode 101 having a plurality of magnets 103, 104, ... embedded therein wherein the electrode is inserted inside a plasma chamber 110 (abstract).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the magnetic arrangement as taught by Kin in the apparatus of Bhardwaj

et al in view of Ohkawa et al in order to protect the magnets from plasma when the magnetic field generating device is disposed inside the plasma chamber.

Claims 14, 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bhardwaj et al (EP 0822582 A2) in view of Ohkawa et al (EP 0831516 A2) as applied to claims 1, 4, 6-9, 12, 21 above, and further in view of Ribeiro (US Patent No. 4,769,101).

Bhardwaj et al in view of Ohkawa et al teach all limitations of the claims as discussed above except for the attenuation means (magnetic generating filed) is temperature controlled.

Ribeiro teaches a plasma processing apparatus (Fig. 1) including a magnet coil 51 cooled by a cooling system 52 having a cooling-fluid line 53 (column 6, lines 22-33).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to implement cooling mechanism as taught by Ribeiro in the apparatus of Ohkawa et al in order to control the temperature of the magnets particularly if it is desired to dispose the magnets inside the chamber.

Claims 14, 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bhardwaj et al (EP 0822582 A2) in view of Ohkawa et al (EP 0831516 A2) as applied to claims 1, 4, 6-9, 12, 21 above, and further in view of Maeno et al (US Patent No. 6,060,836).

Bhardwaj et al in view of Ohkawa et al teach all limitations of the claims as discussed above except for the attenuation means (magnetic generating filed) is temperature controlled.

Maeno et al teach a plasma processing apparatus (Fig. 1) including permanent magnets 40 cooled by a water-cooled structure comprising a cooling water passage (not shown) within the central conductor 22 in order to remove heat generated by plasma and thus to protect the magnets (column 5, lines 60-65).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to implement cooling mechanism as taught by Maeno et al in the apparatus of Bhardwaj et al in view of Ohkawa et al in order to remove heat from the magnets particularly if it is desired to dispose the magnets inside the chamber.

Response to Arguments

Applicants have amended claim 1 to particularly reciting the attenuating means for *partially* reducing the ion flux from plasma.

The Examiner agues a magnetic generating device creating a magnetic field in a direction such that plasma electrons are directed towards the chamber sidewall would inherently partially reduce the plasma ion flux. Further as discussed on page 22, Fig. 6, of the present application a grid (perforated plate or perforated partition panel) would also reduce the plasma ion flux during the process of the passage of the ions through the holed in the grid.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Tsubaki et al (US Patent No. 5,647,944)and Lee et al (US Patent No. 5,968,275) teach a plasma reactor including a plasma distribution member disposed between a plasma region and process region wherein plasma ion flux is inherently partially reduced as ions pass through the distribution member.

Lagarde et al (US Patent No. 6,403,490 B1) teach a plasma reactor including a series of magnets disposed between two parallel electrodes for oscillating electrons between magnetic poles;

Watanabe (JP 2-118055 A) teach a plasma reactor including a magnet 11 cooled by a cooling mechanism as shown in Fig. 1; and

Okudaira et al (US Patent No. 4,985,114) teach an apparatus wherein alternately etching and deposition gases are introduced into a reaction chamber at predetermined time intervals.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Parviz Hassanzadeh whose telephone number is (571)272-1435. The examiner can normally be reached on Tuesday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory Mills can be reached on (571)272-1439. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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Art Unit 1763

April 21, 2004